

Avogadro's law—the safest foundation on which to build modern chemistry—is directly deducible from the fundamental equation of Clausius:—

$$\phi = \frac{nmc^2}{3v}$$

so that not only does our modern system of chemistry rest on a thermodynamical basis, but the future of chemical generalisation—judging from the tendency of recent research—lies in this direction also. The subject of heat has received great additions; the laborious determinations of the specific heats of solutions by Thomsen furnish material for three pages. The “heat of chemical action” has developed enormously through the labours of Thomsen, Hautefeuille, Ditte, and Marignac. Berthelot has also contributed largely to the subject by his thermochemical researches. In industrial chemistry we find much valuable matter added to the metallurgy of iron, the article bringing us down to the invention of Siemens' rotative furnace for obtaining malleable iron and steel directly from the ore. In light, perhaps the most substantial additions to science are to be found in Gladstone's calculations of refraction equivalents, Christiansen, Kundt, Soret, and Sellmeier's researches on anomalous dispersion, and Rammelsberg's researches on the relations between circular polarisation and crystalline form. The articles on the chemical action of light and spectral analysis, contributed by Prof. Roscoe, are excellent *résumés* of the present state of knowledge in these branches of chemical physics. In the latter subject great progress has been made through the labours of Lockyer (discovery of long and short lines in metallic spectra), Roscoe and Schuster (new absorption spectra of potassium and sodium), and Lockyer and Roberts (new absorption spectra of various metals—suggestions for a possible quantitative spectrum analysis).

Prof. G. C. Foster contributes the article on magnetism, and Prof. Armstrong that on the phenols. Most of the articles on physiological chemistry are from the pen of Dr. H. Newell Martin; and Mr. R. Warington furnishes some valuable articles on subjects relating to agricultural chemistry.

The second supplement exhibits all the care and painstaking conscientiousness of the former volumes, and will be found of invaluable service both to teachers and workers. The names of Mr. Watts and his coadjutors sufficiently guarantee the reliability of the work; the “Dictionary” has in fact justly taken its rank as one of the standard works of reference in this country.

Seeing that the results of chemical research are flowing into the scientific world in a continuous and ever increasing polyglot stream, both professors and students of the science are indebted to Mr. Watts for the laborious task which he has accomplished for their benefit.

For our own part we look with eager interest upon the continuous encroachment of physics upon chemistry, and venture to hope that the time may not be far distant when generalisation may lead to natural classifications, causing the handbooks and dictionaries of the future to be for the same quantity of information somewhat less bulky in volume.

R. MELDOLA

#### HIS ON MORPHOLOGICAL CAUSATION

*Unsere Körperform und das physiologische Problem ihrer Entstehung.* Briefe an einen befreundeten Naturforscher, von Wilhelm His. (Leipzig: Vogel, 1875. London: Williams and Norgate.)

THIS is not, as might perhaps (from its title and from a hasty glance at its contents) be imagined, a popular exposition of the main facts of Embryology as ordinarily understood. Prof. His has been led by his researches to adopt peculiar views concerning the causation of animal forms. These he has explained at some considerable length in his great work on the “Development of the Chick,” and elsewhere, but they have not met with very general acceptance; and the little work we are noticing has for its object a popular and somewhat fuller explanation of these views, and a defence of them against various critics. Among these critics the most conspicuous is Haeckel, whose, to say the least, severe remarks on the author have occasioned a very spirited retaliation. In fact the work, small as it is and popular as it is intended to be, is very largely controversial; and it has always appeared to us a sign of weakness when a scientific combatant brings his quarrel before a general public.

Without going at all fully into the views of our author, we may say that he strives to explain many of the facts of animal morphology by the agency of mechanical causes acting directly on the growing germ or embryo. Thus, for him the large eyes of the young chick are the direct cause, by compression, of the sharp beak of the bird; and more generally the unequal tensions produced by unequal growth in the initial flat blastoderm determine, through the agency of certain folds, the form of the animal which springs from it.

As might be expected, many pages of the book are devoted to an attempt at reconciling these views with a modified theory of descent. Speaking broadly, the views of the author may be said to differ from those generally entertained, chiefly on the question whether it is the horse which pulls the cart or the cart the horse, or perhaps rather on the point which is the cart and which the horse. We very much fear that Prof. His's horse is really the cart.

M. F.

#### OUR BOOK SHELF

*Bristol and its Environs, Historical and Descriptive.*

Published under the sanction of the Local Executive Committee of the British Association. (London: Houlston and Sons. Bristol: Wright and Co., 1875.)

It was some time ago announced that a Guide to Bristol was being prepared for visitors to the British Association Meeting. This is now published, and appears as an 8vo volume of 475 pages bound in cloth. In many respects the local committee have made great exertions to make the visit in every way a pleasant one, and this has been pretty well known, but so voluminous a guide as this is certainly a surprise. It is well got up, and is illustrated both with views of the buildings in the town and with diagrams illustrative of the geology of the district. Many pens have been employed in its preparation. “The contributions,” the Introduction states, “are honorary—the several authors have written with pure love of their subject, and for the sake of doing homage to the occasion that has called forth the volume.”

The first two sections, both of them on Ancient Bristol, are by Mr. J. Taylor, of the Bristol Library. Section 3, on Modern Bristol, is by Mr. J. F. Nicholls, of the City Library. The fourth section, on Local Government and Taxation, is by Mr. H. Naish : and then follows a section on Educational Organisations, to which there are several contributors. Mr. D. Davies, the medical officer of health, has supplied the section on Sanitary Condition and Arrangements, after which comes Section 7, on Physical Geography and Geology. This occupies sixty-four pages, and would perhaps have been of more practical use if printed as a separate pamphlet that could be conveniently carried in the pocket. Mr. Tawney has written the Introduction ; the Silurian, the Carboniferous, and Millstone Grit is by Mr. Stoddart ; the part on the Coal Measures and "New Red Period" is written by Mr. Tawney ; that on the Rhætic and Liassic by Mr. Ralph Tate, and the concluding part on the Inferior Oolite is again by Mr. Tawney.

Bristol is better off for geological maps than any other part of the country, for not only are there the sheets of the Geological Survey, but there is Mr. Sanders' splendid map of six inches to the mile, which includes the whole of the Bristol coal-field.

It is a pity there was not a sketch map introduced in the guide, with just the names given of the places referred to and an indication of the spots where the sections are taken from. As it is, strangers to the district will experience some difficulty in following the text, as many of the names are not on the published maps. With regard to the sections, too, there is no indication of the direction in which they are taken, nor of the scale to which they are drawn. One of the most useful features of the geological portion is that which gives the localities where the sections of the strata can be seen ; and, as the district within a short distance contains from the Silurian up to the Oolites, omitting the Permian, is of interest. There are many references to the more important papers that have been printed, and in cases of difference of opinion the writer has added his own views. The much vexed question of the age of the "dolomitic," "triassic," "magnesian," or "reptilian" conglomerate, is duly referred to.

The notes on anthropology have reference to the tumuli and chambered barrows, and to the present condition of Bristolians. "A certain amount of physical degeneration has taken place among the native Bristolians, as among the natives of other British cities ; 300 of them yielded to me an average stature and weight of 5 feet 5·8 inches and 132½ lbs., after deductions made for shoes and clothing. The average height of men in the surrounding counties may fairly be put at half an inch more."

The book has one serious defect, for which the compiler and not the authors are responsible ; there is no index.

## LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

### "Climate and Time"

THE review of "Climate and Time" in NATURE, vol. xii. p. 121, contains some remarks in reference to my tables of the eccentricity of the earth's orbit, to which, in justice to myself, I must refer, the more so as they relate to points which comparatively few of your readers have it within their power to determine whether or not the reviewer was justified in making the remarks in question.

"We have repeated," says the reviewer, "the calculations for two of the most remarkable dates, viz., 850,000 and 900,000 years ago respectively, and find that at the former date the eccentricity was '0697 instead of '0747, and at the latter date was '0278 instead of '0102 as expressed in the table."

What proof does the reviewer give that his results are correct and mine incorrect ? The following is the reason he assigns :—"To satisfy ourselves," he says, "that the mistakes are Mr. Croll's and not ours, we have recalculated also one of Mr. Stone's and one of M. Leverrier's, and in both instances have exactly verified them." This can hardly be accepted as sufficient evidence, for I had myself recalculated one of Mr. Stone's and no fewer than five of M. Leverrier's, "and exactly verified them."

I suspect that the reviewer has made his calculations somewhat too hastily ; for if he will go over them a little more carefully, he will, I have no doubt, find that after all my results are perfectly correct, excepting only a trifling typographical error, to which I shall presently refer.

The value for 900,000 years ago ought to be '0109 instead of '0102, as stated in the table. This mistake arose out of the curious circumstance of a small speck of ink having been dropped on the tail of the 9, which led to its having been substituted for a 2, ten years ago when the tables were first published—a fact of which I was not aware till a week or two ago, when looking over the manuscripts of my original calculations, all of which I have preserved. Since my calculations were called in question by your reviewer, I have had them examined by three experienced mathematicians, and the conclusion at which each of them has arrived is that they are perfectly correct.

The reviewer continues :—"The fact that the eccentricity was large when he represents it so, and small when he makes it small, seems to indicate that some approximating progress [progress ?] has been followed, and that possibly his diagram may give a rough idea of the changes of eccentricity for past time."

I can assure the reviewer that nothing could be further from the truth than this assumption. I have computed the eccentricity and longitude of the perihelion for no fewer than 129 separate periods, and in every case Leverrier's formulæ have been rigidly followed, and I have every reason to believe that the diagram gives not a rough but an accurate idea of the changes of eccentricity. The values given in the tables will, I trust, be found to be perfectly accurate up to at least the fourth place of decimals, which is as far as these formulæ can be relied upon to yield correct results.

The following are the results which, considering the trouble that has been given to their verification, I think will stand the most severe scrutiny :—

Period 850,000 years ago.	Period 900,000 years ago.
$h^2 = \cdot 00413927$	$h^2 = \cdot 000059858$
$l^2 = \cdot 00144124$	$l^2 = \cdot 000059812$
$h^2 + l^2 = \cdot 00558051$	$h^2 + l^2 = \cdot 000119670$
$\sqrt{h^2 + l^2} = \cdot 0747 = \text{Eccentricity}$	$\sqrt{h^2 + l^2} = \cdot 010939 = \text{Eccentricity}$
Edinburgh, August 10	JAMES CROLL

### A Lunar Rainbow, or an Intra-lunar convergence of Streams of slightly illuminated Cosmic Dust ?

ABOUT 8.30 P.M. yesterday a large zone of the sky, from the horizon at W.N.W. to the horizon at E. by S., was illuminated in a very remarkable manner, and this illumination lasted about three-quarters of an hour, when it gradually died out.

During all this time the sky was very clear and cloudless, thereby forming a dark back-ground, on which the phenomenon, whether lunar rainbow, or many rainbows, or intra-lunar converging streams of cosmic matter, was splendidly projected.

This exhibition consisted of one grand central feather springing out of the horizon at W.N.W. and crossing this meridian at about 20° north of the zenith. The width of this stream, with little variation throughout its length, was 7° or 8°. Its light was that of a very bright white cloud, its edges most beautifully defined ; its form that of a very elongated feather, but without any shaft. On either side of this main feather was a system of seven or eight minor and fainter streams, threads, or beams of light, all more or less extending from the western to the eastern horizon, subtending a chord common to themselves and to the main stream of light, and converging towards the axis of the central stream so as apparently to intersect it at a point about 30° or 40° below the western horizon, at which the whole system subtended an azimuth of about 20° ; and near the zenith, where its transverse section was a maximum, that section subtended an angle of about 40°. At this time the moon was about 15° east of the meridian, and her declination about 9° S. Both systems of the minor streams of light on the sides of the main stream appeared to have a slight